

REMARKS

Favorable reconsideration of this application, as presently amended, is respectfully requested.

Claims 1 and 5-14 are now active in this application. Claims 2-4 and 15-20 have been cancelled. Claim 1 has been amended to include the limitations previously found in Claim 2. Claims 13 and 14 have been rewritten in independent form.

The Examiner rejected the claims as being indefinite due to various problems in claim language. By way of the present amendment, Applicants have amended Claim 1 in a number of locations to adopt the suggestions of the Examiner. In regard to the rejection of Claims 4 and 7, Claim 4 has been cancelled. Claim 7 has been amended to use generic term "material". With regard to Claims 7-10, the language regarding sheets and strips has been removed. In Claims 8-10, the indefinite article has been utilized in regard to "exit". In regard to Claims 13 and 14, these claims have now been amended to be independent and thus no longer relate to the method.

Before discussing in detail the remaining rejection of the claims, it is believed that a brief review of some of the significant aspects of the present invention is in order. The present invention relates to a method and apparatus for manufacturing a composite material. The composite material is made of reinforcing fibers such as glass fibers and a thermoplastic organic material. The composite is made of at least two layers with one of the layers being a knit or fabric material. The other layer is made of chopped threads. A conveyor is utilized to move the layers. The first layer on the conveyor can be either the chopped threads or the material, with the other then being placed thereupon. A third layer may be added which is similar to the first layer. A fourth layer may also be added which is similar to the second layer if desired. The conveyor carries the composite to an oven where it is heated and then through

heated rollers and finally cooled rollers before it is cut into sections.

The Examiner rejected Claims 1, 3-6, 12, 16, 18 and 20 as being obvious over O'Connor in view of one of Kwok, Scott, or Hunter. Claims 2, 7-11, 13-15, 17 and 19 were rejected over the same combination and further in view of Vane. Since the limitations of Claim 2 have now been incorporated into Claim 1, Applicants submit that the original rejection of Claim 1 is now overcome but that Claim 1 will be discussed in regard to the rejection originally applied against Claim 2.

The Examiner cited the O'Connor reference as showing the manufacture of a composite article including thermoplastic fibers and reinforcement fibers. The composite material is subjected to heat and pressure followed by cooling. The composite either may be a mat of commingled fibers or a fabric formed by commingling the two fibers followed by weaving into a fabric.

The O'Connor patent discloses the possibility of producing a composite product using co-mixed fibers either in the form of a fabric or in the form of a chopped strand mat. However, it does not in anyway involve combining the two reinforcement presentations in order to manufacture a composite product. The only examples describe the use of a fabric. This reference also indicates that the reinforcement ratio used can be high and represent from 40 to 80 w% of the fabric used. The other side of this type of reinforcement ratio is that the time required for obtaining a part by molding is very long. It is first necessary to soften and melt the organic material so that it comes into intimate contact with the reinforcement. It is also necessary for the entrapped air to be able to escape. According to the reference, the interval generally is from 10 to 20 minutes but can last as long as 60 minutes. Even in Example II, the part obtained is a simple sheet and the molding time was 15 minutes. This reference does not suggest any means for making the molding of a part containing a high

reinforcement ratio less difficult, especially if this involves a part with a complex shape, nor for reducing the molding time in order to reduce the manufacturing costs for such parts.

The secondary references, Kwok, Scott and Hunter were all cited to show the use of a conveying apparatus onto which a batt is formed.

The Examiner considers the production of a chopped strand mat on a travelling conveyor to be commonplace. However, this mat is subjected to mechanical treatments such as needle bonding or carding. These operations bind the fibers together and are necessary in order to give the mat bonding strength. In Scott and Kwok carding is used while needle bonding is used in Hunter.

The Examiner cited the Vane reference to show the concept that layers are formed upon one another in order to make a composite article when fed through a device applying heat and pressure. This patent discloses layers of uni-directional fibers that are also mechanically bound together. The teaching of this patent in no way suggests the present invention.

Applicants have now amended Claim 1 to include additional limitations. Specifically, the claim now requires that two layers be deposited on a conveyor where one of the layers is formed of commingled threads and the other layer is a fabric material made of commingled threads of glass filaments and filaments of thermoplastic organic material. The composite formed is transferred into zones where it is heated, compressed and cooled and then cut into sheets. Thus, the claim now makes it clear that one layer must be glass threads while the other layer must be a strip of material. Applicants submit that this particular arrangement is not seen in the references. The Examiner admits that the primary and secondary references fail to describe the formation of plural layers of composite material.

The Examiner relies on the Vane reference to show such layering. However each of

the layers shown in Vane consist of a plurality of unidirectional non-woven yarns or threads laid side-by-side, with layers being stitched together after assembly. This differs from the present invention where one of the two layers is a strip of material off a roll which is preformed and the other layer is formed of glass threads. The Vane reference does not teach this concept of having "sandwiches" which alternates strips of material with layers of threads. This arrangement facilitates the formation of the composite and makes it possible to manufacture continuously a composite product. It also allows the content of reinforcing fibers to be higher than in previous processes.

New Claim 1 defines the heart of the invention, that is, a process for manufacturing a composite that is specially adapted for obtaining parts of a complex shape by molding or die stamping. As indicated in the specification, the product combines the ability to mold specific products that contain non-woven reinforcements with a level of mechanical properties that characterize products containing woven reinforcements. From the standpoint of the process, this is expressed by the combination of at least one layer of woven reinforcement and at least one layer of non-woven reinforcement. During molding of the final part, the unwoven reinforcements, such as chopped or continuous strands, will spread under the effect of pressure into the smallest recesses of the mold while the woven reinforcements (fabrics or knit fabrics) will simply take on the shape of the mold. Therefore, in the final part, whose shape can be very complex, the reinforcement ratio at any point is virtually constant. Another advantage of the process is that the reinforcement and thermoplastic organic material are already firmly combined which makes it possible to reduce molding time considerably and to obtain a very homogenous part despite the high reinforcement ratio used.

Applicants furthermore submit that the present claimed process would not be obvious to one skilled in the art since there is no teaching in the references of the concept of using a

preformed sheet of material as one of the layers. The prior art has not appreciated the advantages of having such a sheet as one of the layers. The present inventors have appreciated the advantages obtained by this process. Without this insight, the present claimed process would not be obvious. Accordingly, Applicants submit that Claim 1 defines over these references.

Claims 5-12 depend from Claim 1 and as such are also considered to be allowable. In addition these claims recite other features of the claimed process such as the form of the threads, the order of the layers and more details of the heating, cooling and compressing zones. Many of these features are also not shown in the references and accordingly these claims are believed to be additionally allowable.

Claims 13 and 14 are now independent claims which recite the characteristics of the device which implements this process. Thus these claims include storage devices for the threads, the devices for holding two rolls of fabric, the preheating oven, twin belt press, cooled rolls and the automatic guillotine device. This particular arrangement of elements is also not seen in the references and accordingly these claims are believed to be allowable as well.

In summary then, it is respectfully submitted that the references of record whether taken individually or in combination do not anticipate or obviate the structure which is fully disclosed and positively claimed in the present application. In view of this, it is submitted that

the inventions defined by each of Claims 1 and 5-14 are patentable and a favorable reconsideration and early allowance of the present application is therefore respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,  
MAIER & NEUSTADT, P.C.



Gregory J. Maier  
Registration No. 25,599  
Robert F. Gnuse  
Registration No. 27,295  
Attorneys of Record

Crystal Square Five - Fourth Floor  
1755 Jefferson Davis Highway  
Arlington, VA 22202  
(703) 413-3000  
Fax #: (703) 413-2220  
RFG/smi